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Interference, Management, and Growth Response of Wild Poinsettia (Euphorbia Heterophylla L.) in Soybean.

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INTERFERENCE, MANAGEMENT, AND GROWTH RESPONSE OF WILD POINSETTIA (*Euphorbia heterophylla* L.) IN SOYBEAN

A Dissertation

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by
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ABSTRACT

In field studies conducted in Louisiana in 1990 and 1991, area of influence, density, and duration of interference methodologies were used to evaluate wild poinsettia (*Euphorbia heterophylla* L.) interference in soybean (*Glycine max* (L.) Merr.). In 1990, soybean seed yield within 10 cm of wild poinsettia was similar to distances of 10 to 20 and 20 to 40 cm, but was less than that for distances greater than 40 cm from the weed. In contrast, soybean yields in 1991 growing within 10 cm of the weed were less than at greater distances. Weed interference resulted in a 9.4 and 18% reduction in soybean seed yield within 10 cm of the weed in 1990 and 1991, respectively, when compared with 80 to 100 cm. Full-season interference of 8 wild poinsettia per 6 m of row reduced soybean yield 17%. Yield was also reduced 26% from a natural infestation of wild poinsettia after 10 wk of competition.

Postemergence applications of chlorimuron, imazaquin, fomesafen, and acifluorfen following preemergence applications of clomazone, metribuzin, and metribuzin plus chlorimuron at labeled rates enhanced wild poinsettia control when compared with the preemergence herbicides applied alone. Soybean seed yields in both years were generally not increased with additional postemergence

applications, but foreign material in harvested seed was reduced both years.

In other studies, fomesafen, acifluorfen, imazaquin, lactofen, and chlorimuron, applied early postemergence when wild poinsettia plants were 2 to 8 cm tall, improved weed control compared with a late application at 10 to 15 cm in 1 of 2 yr. Soybean seed yields in 1990 for all herbicide treated plots were at least 55% higher than the untreated check. Percent foreign material and moisture in harvested seed were reduced by at least 33 and 25%, respectively, compared with the untreated check. An early freeze in 1991 negated differences in foreign material and moisture content.

In greenhouse and field studies, imazaquin, fomesafen, acifluorfen, and chlorimuron, applied postemergence, provided similar control when applied to weeds 5 to 7 cm and 8 to 10 cm tall, but weed control was less when herbicides were applied at 15 to 20 cm tall. Herbicide application to weeds 8 to 10 cm tall reduced both new weed emergence observed with the earlier application and weed regrowth that is common following the late application. Wild poinsettia seed production was greatest with the later herbicide application.

CHAPTER 1

INTRODUCTION

When considering both cost of control and economic losses, weeds account for 42% of the total costs of pests to agriculture (1.5). Weeds compete with the crop for light, water, nutrients, and space. The degree of competition from a weed can depend on such factors as time of emergence, density, growth rate, and growth habit as well as its ability to produce allelochemicals which can negatively impact the crop.

Wild poinsettia (*Euphorbia heterophylla* L.) is an annual weed native to tropical and subtropical America (1.4) which is capable of abundant seed production. High plant populations can result in severe interference with crops (1.2). Wild poinsettia may remain green at harvest, and the white latex sap contained in the plants can reduce harvesting efficiency. Increased moisture and foreign material in the harvested soybean seed as a consequence of wild poinsettia presence can decrease crop quality, thereby affecting the price received (1.3).

In Louisiana, wild poinsettia has been listed as one of the ten most common and troublesome weeds in soybean (1.8). Soybean, grown primarily for oil and meal production, is an important agricultural crop in the southeastern United States. Soybean hectarage in Louisiana varies from year to year and, as reported in the most recent Louisiana Almanac, ranged from 1.11 million harvested hectares in 1984 to 0.79 million hectares in 1986 (1.1).

Herbicidal control of wild poinsettia has often been inconsistent (1.9), and as the weed exceeds 10 cm control is often inadequate (1.7). It is common for wild poinsettia plants to regrow from lower nodes following postemergence herbicide application (1.6) and to successfully produce seed for the following season.

This dissertation addresses the interaction between wild poinsettia and soybean, and deals specifically with competition, herbicidal control, and regrowth responses. My objectives were: 1) to evaluate the effect wild poinsettia interference on soybean growth and yield using area of influence, density, and duration of interference methodologies, 2) to investigate the impact of preemergence and/or postemergence weed control programs on soybean seed yield and quality parameters, and 3) to determine the effect of time of foliar herbicide application on weed regrowth and reinfestation.

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CHAPTER 2

LITERATURE REVIEW

Wild Poinsettia Biology and Competition. Wild poinsettia (*Euphorbia heterophylla* L.), a weed native to tropical and subtropical America (2.21), is an annual, herbaceous plant which grows 60 to 90 cm tall (2.43). It is found throughout the southeastern United States and in many parts of the world. Holm et al. (2.20) reported that wild poinsettia is a serious weed in Fiji, Ghana, Mexico, and the Philippines; a principal weed in Cuba, Honduras, Italy, Peru, Uganda, and the United States; and present as a weed in 29 other countries.

Wild poinsettia is capable of producing 800 to 1500 seeds m^{-2} (2.13). Rodriguez and Cepero (2.37) observed that wild poinsettia grown in the laboratory in an improved gray soil with carbonate produced an average of 106 seeds per plant. Germination of 95 to 100% has been observed in both field and laboratory experiments (2.13). Langston (2.25) reported 81% of seeds buried at 5 cm produced seedlings the following season. Brecke (2.5) observed 80% and 20% emergence of seeds planted at a 2 to 4 cm and 14 cm depth, respectively. Dense stands of 50 to 100 plants m^{-2} can result in severe competition with crops (2.13). Wild poinsettia plants often remain green at harvest and contain a white latex sap which can interfere with harvesting efficiency and may lead to increased moisture of harvested seed (2.17). In addition, high populations may prevent harvesting of the soybean crop (2.32).

Competitive effects of wild poinsettia, specifically in soybean, were previously studied by Harger and Nester (2.17), who observed that 8 wild poinsettia plants per meter of row reduced soybean yields 18, 22, and 33% with 8 and 12 wk of competition, and full season competition, respectively. In a similar study Chemale and Fleck (2.8) found 16 and 50% soybean yield reductions when 54 wild poinsettia plants m^{-2} competed for 45 and 115 days after crop emergence, respectively. When soybean seed were planted April 24 in southern Louisiana, 6 wk of weed removal were needed to obtain crop yields similar to the weed-free control (2.25). When planted on June 14, however, only 3 wk of weed removal were required, indicating that late-season emerging weeds are less competitive.

Wild poinsettia interference in peanuts has been evaluated. Royal et al. (2.39) observed decreased yields of 107 kg ha^{-1} for each wild poinsettia plant per 9.1 m of row. Peanut seed yield reductions were observed when wild poinsettia competed for longer than 8 wk and a 10 wk weed-free period was required to achieve yields similar to the weed-free check. In Georgia, 4 or more plants per 9.7 m of row reduced peanut yields (2.6). Yield losses of 30 to 50%

were observed when 32 plants per 9.7 m of row were present. Yield losses occurred when wild poinsettia were present for more than 3 wk after peanut emergence and a 8 to 10 wk weed-free period was needed to avoid yield reductions. Brown (2.7), however, reported that wild poinsettia control in peanuts for up to 10 wk can still result in a 20% yield reduction.

Weed-Crop Interference. Weed interference is defined as the ability of a weed to adversely affect crop growth (2.38). Specifically, interference comprises both competition, which implies that the weed and crop are vying for the same resources, and allelopathic effects of the weed. The degree of competitiveness of a weed depends on the time of emergence in relation to crop emergence, the growth habit of the weed, and the density present (2.38).

Additive, replacement, and systematic methods for determining weed competition and the advantages and disadvantages of each were discussed by Oliver and Buchanan (2.34). Density, duration of interference, and area of influence weed interference studies are considered as additive methods of weed competition research. Density and duration of interference studies are directly applicable to crop production and yield losses, while the area of influence study serves to determine the degree of influence of an individual weed species on a crop.

Density and duration of interference studies have been conducted in soybean with cocklebur (*Xanthium strumarium*) (2.3, 2.4), tall morningglory (*Ipomoea purpurea*) (2.35, 2.45), ivyleaf morningglory (*Ipomoea hederacea*) (2.11, 2.45), velvetleaf (*Abutilon theophrasti*) (2.19), venice mallow (*Hibiscus trionum*) (2.12), jerusalem artichoke (*Helianthus tuberosus*) (2.46), jimsonweed (*Datura stramonium*) (2.23), ragweed (*Ambrosia artemisiifolia*) (2.10), sicklepod (*Cassia obtusifolia*) (2.41), pennsylvania smartweed (*Polygonum pensylvanicum*) (2.9), hemp sesbania (*Sesbania exaltata*) (2.29), johnsongrass (*Sorghum halepense*) (2.44), and quackgrass (*Apropyron repens*) (2.47).

Regardless of the weed species, soybean can generally withstand competition for 4 to 8 wk after emergence before yield losses are observed (2.3, 2.9, 2.11, 2.12, 2.29, 2.35, 2.41, 2.44, 2.46). Weeds differ in their competitive ability; cocklebur is very competitive while grasses are less competitive (2.30). Cocklebur and johnsongrass reduced soybean yields 63 to 75% and 23 to 42%, respectively.

Area of influence studies, as described by Oliver (2.33) and Oliver and Buchanan (2.34), are used to determine the extent of damage caused by the interference of a weed with a crop by measuring the area of influence of a single weed within the crop. Growth and yield parameters from such studies can be measured and the information used in computer models of weed-crop interference.

Area of influence studies in soybean have been conducted using common cocklebur (2.16, 2.31), johnsongrass (2.31), Palmer amaranth (*Amaranthus palmeri*) (2.31), sicklepod (2.16, 2.31, 2.36), tall morningglory (2.31), and jimsonweed (2.18).

Weed Management. The time of application of a herbicide often determines its effectiveness on target weeds. Herbicides may be applied preplant, preemergence, or postemergence (2.24). Preplant herbicides are applied prior to the planting of the crop, preemergence herbicides are applied prior to the emergence of the crop and/or weed, and postemergence herbicides are applied after emergence of the crop and/or the weed.

Preemergence treatments have provided varying levels of wild poinsettia control (2.2, 2.14, 2.15, 2.17, 2.32, 2.42). Control with clomazone was excellent. Linuron controlled 50 to 60% of wild poinsettia, alachlor 40 to 50%, and imazaquin 70 to 80%, while metribuzin controlled 10 to 100%, but primarily was 60 to 70%. Metribuzin plus chlorimuron gave poor control of wild poinsettia.

Postemergence herbicides have generally enhanced wild poinsettia control when compared with preemergence herbicides (2.2, 2.14, 2.15, 2.17, 2.32, 2.40). Bentazon, acifluorfen, imazaquin, chlorimuron, fomesafen, and lactofen have all controlled 90% or more of wild poinsettia when applied early. However, as the weed exceeds 10 cm in height, control becomes more erratic (2.32). Harger and Nester (2.17) reported increased control with bentazon and acifluorfen when applied to 7.5 cm tall wild poinsettia compared with 15 cm.

Preemergence followed by postemergence herbicides have also provided favorable wild poinsettia control (2.14, 2.15). Better than 90% control was achieved with labeled rates of preemergence/postemergence combinations of imazaquin/imazaquin, chlorimuron/chlorimuron, and metribuzin plus chlorimuron/chlorimuron.

Wild poinsettia regrowth from lower nodes is common when inadequate control is obtained. Such plants have been observed to produce seed contributing to problems in subsequent years. In Florida, Jowers et al. (2.22) reported that wild poinsettia often survived salvage postemergence herbicide treatments applied when soybean plants were in early bloom. Following a post-directed treatment of paraquat, wild poinsettia regrew from nodes below the area girdled from the herbicide.

Langston et al. (2.26) noted that wild poinsettia was capable of producing adventitious shoots following herbicide applications. In addition, plants were capable of producing axillary shoots arising from cotyledonary nodes. Axillary shoot formation and adventitious regrowth are means by which the weed can recover from herbicide treatment when total control is not obtained.

Weed control often increases crop yield but can also improve crop quality by decreasing moisture and/or foreign material. This added advantage of herbicide application is often overlooked. The effects of common cocklebur control levels on the grade components of soybean have been investigated (2.1, 2.27, 2.28). Foreign material was 0.7% and 5.1% with total common cocklebur control and no control, respectively (2.1). Common cocklebur control of 70% or more was required to prevent deductions due to moisture in excess of 13%.

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CHAPTER 3

INTERFERENCE OF WILD POINSETTIA WITH SOYBEAN

INTRODUCTION

Area of influence studies, as described by Oliver (3.12) and Oliver and Buchanan (3.13), are used to determine the extent of damage caused by the interference of a weed species within a crop. Both growth and yield parameters can be measured, and the information used in computer models of weed-crop interference. Area of influence studies in soybean have evaluated the effects of common cocklebur (*Xanthium strumarium* L.) (3.5, 3.11), johnsongrass (*Sorghum halepense* (L.) Pers.) (3.11), Palmer amaranth (*Amaranthus palmeri* S. Wats.) (3.11), sicklepod (*Cassia obtusifolia* L.) (3.5, 3.11, 3.14), tall morningglory (*Ipomoea purpurea* (L.) Roth) (3.11), and jimsonweed (*Datura stramonium* L.) (3.7). In cotton, area of influence techniques have been used to study unicorn plant or devil's-claw (*Proboscidea louisianica* (Mill.) Thellung) (3.1, 3.10), velvetleaf (*Abutilon theophrasti.* Medik.) and wild okra (*Abelmoschus esculentus* (L.) Moench) (3.1), common cocklebur (*Xanthium strumarium* L.) (3.2), spurred anoda (*Anoda cristata* (L.) Schlecht.), large crabgrass (*Digitaria sanguinalis* (L.) Scop.), jimsonweed (*Datura stramonium* L.), common lambsquarters (*Chenopodium album* L.), redroot pigweed (*Amaranthus retroflexus* L.), common ragweed (*Ambrosia artemisiifolia* L.), sicklepod (*Cassia obtusifolia* L.), and prickly sida (*Sida spinosa* L.) (3.3).

Wild poinsettia is listed among the ten most common weeds in Louisiana soybean and among the ten most troublesome weeds of soybean in Louisiana and Georgia (3.15). The adverse effects of the weed, however, are not limited to the southeastern United States. Although the weed originated in tropical and subtropical America (3.9), it is now common in many areas. Holm et al. (3.8) reported that wild poinsettia is a serious weed in Fiji, Ghana, Mexico, and the Philippines and a principal weed in Cuba, Honduras, Italy, Peru, Uganda, and the United States. It is also present as a weed in 29 other countries.

Competitive effects of wild poinsettia in soybean were previously studied by Harger and Nester (3.6). With 8 wild poinsettia plants per meter of row, soybean yields were reduced 18, 22, and 33% with competition for 8 wk, 12 wk, and full season, respectively. In a similar study conducted by Chemale and Fleck (3.4), 16 and 50% reductions in soybean yields were noted when 54 plants m^{-2} competed for 45 and 115 days after soybean emergence, respectively. These studies indicate that with high plant densities, significant yield reductions can occur.

To more fully evaluate the competitiveness of wild poinsettia in soybean, these field studies were conducted using area of influence methodology to evaluate wild poinsettia interference on soybean growth and yield. In addition, duration of interference treatments were included to further delineate weed competitiveness. The effect of soybean interference on wild poinsettia development was studied as well.

MATERIALS AND METHODS

Field studies were conducted in 1990 and 1991 in Baton Rouge, LA on a Mhoon silty clay loam soil (fine-silty, mixed, nonacid, thermic Fluventic Haplaquepts). 'Asgrow 6785' soybean seed were planted in rows spaced 76 cm apart on June 8, 1990 and June 2, 1991. In 1990, weed seeds were soaked for 8 hr and planted in the field on June 8. In 1991 for ease of establishing weeds in the field, weed seeds were soaked 8 hr and planted in peat pellets in the greenhouse and transplanted to the field on June 10. Soybean plants were thinned to 1 per 5 cm of row after stand establishment both years. Plots were 10 m long and 4 rows wide with soybean planted on rows 1 to 3. Rows 2 and 4 each contained 2 wild poinsettia planted 3 m from each end of the plot. Both years metolachlor at 2.2 kg ha^{-1} was applied after planting for annual grass control, and plots were maintained weed-free throughout the remainder of the season.

The two weeds were planted within the second soybean row to facilitate both yield determinations and destructive harvests for biomass accumulation. Wild poinsettia were grown within the soybean row (row 2) and alone (row 4) to quantify the competitive effects of soybean on wild poinsettia.

Wild poinsettia were totally removed from individual plots at 2 wk intervals beginning 2 wk after soybean emergence and continuing through 18 wk. At weed removal, plant width, plant height, fresh weight, and dry weight were recorded. Dry weight was determined by placing plant samples in a dryer at 60°C until weights remained constant. The same parameters were measured on soybean plants within 0 to 10, 10 to 20, 20 to 40, 40 to 60, 60 to 80, and 80 to 100 cm distances on either side of the weed. The 80 to 100 cm distance was used as a control for comparison. Changes over time are reflective of soybean growth rather than the adverse effect of the weed on the crop.

At harvest, data including plant number, 100-seed weights, and total seed weights were collected on soybean plants at the same intervals away from the weed as described previously. Plots were hand-harvested and threshed. Seed weights were measured after cleaning and drying at 60°C to constant weights. Soybean data represent an average of data collected on either side of the weed for individual treatments.

A split-plot experimental design with ten replications was used. For the soybean data, time of wild poinsettia removal was the whole plot and distance from the weed was the subplot. For the wild poinsettia data, the presence or absence of soybean interference was assigned to the whole plot and time of weed removal assigned to the subplot. Data were analyzed by year and across years, and all interactions were tested for significance. Data are presented according to significant interactions. Soybean data were analyzed using plant number as a covariate. All data were subjected to analysis of variance, least squares means computed, and means separated using Fisher's Protected LSD values at the 5% probability level.

RESULTS AND DISCUSSION

Soybean data collected at 2 wk intervals throughout the season indicated the beginning of interference, the magnitude of the effects, and the size of the area within the crop row influenced by the weed. Even though wild poinsettia height exceeded that of soybean beginning at 10 wk, crop height was not affected by wild poinsettia interference (data not shown). Similarly, Perry (3.14) reported no adverse effect on soybean height from sicklepod competition. Soybean canopy widths averaged across years, however, were reduced approximately 10% beginning at 6 wk of interference for both 0 to 10 and 10 to 20 cm distances when compared with the 80 to 100 cm distance (Table 3.1). In addition, for the 0 to 10 cm distance, reduction compared with 80 to 100 cm ranged from 6.5 to 15.9% for 10 through 18 wk of interference. In other studies, sicklepod began to influence soybean development within 8 to 12 wk after planting (3.5, 3.14), cocklebur at 10 to 12 wk of interference, and jimsonweed at 10 wk (3.7).

Soybean fresh weight was not affected by wild poinsettia presence until 12 wk of interference. At 12 and 14 wk of interference, fresh weights declined 30 to 34% within 10 cm of wild poinsettia when compared with the 80 to 100 cm distance, while reductions of 37% within 10 to 20 cm were noted at 16 wk (Table 3.2). Similar responses were noted for soybean dry weights, and significant reductions ranging from 14.3 to 37.8% were noted within 20 cm of wild poinsettia for 12 through 18 wk of interference (Table 3.3). Palmer amaranth reduced soybean biomass within 12.5 cm after 8 wk of interference and 50 cm after 16 wk, while johnsongrass, sicklepod, and tall morningglory did not affect soybean biomass production (3.11).

In 1990, soybean seed yield within 10 cm of wild poinsettia was similar to that noted for 10 to 20 and 20 to 40 cm, but was less than yields for distances greater than 40 cm from the weed (Table 3.4). Weed interference resulted in a 9.5% yield reduction in the 0 to 10 cm distance compared with the 80 to 100 cm distance. In 1991,

Table 3.1. **Soybean canopy width as influenced by duration of wild poinsettia interference and distance from the weed within the soybean row in Baton Rouge, LA.**

Weeks of interference	Distance (cm)					
	0-10	10-20	20-40	40-60	60-80	80-100
	(cm)					
2	11.8[a]	13.4	10.5	12.4	12.1	11.9
4	36.6	37.1	36.9	37.5	36.8	38.6
6	47.2	46.9	51.7	50.5	52.9	52.7
8	56.9	58.4	63.5	65.0	61.8	61.5
10	73.4	74.6	80.9	79.0	77.3	79.9
12	71.6	74.9	76.7	74.9	77.7	76.6
14	66.8	76.4	73.0	77.3	77.5	77.5
16	74.3	69.7	80.8	79.1	78.8	80.0
18	27.6	28.1	31.8	31.3	34.7	32.8
LSD (0.05)	4.7					

[a] Values represent an average of 1990 and 1991.

Table 3.2. **Soybean fresh weight as influenced by duration of wild poinsettia interference and distance from the weed within the soybean row in Baton Rouge, LA.**

	Distance (cm)					
Weeks of interference	0-10	10-20	20-40	40-60	60-80	80-100
	(g)					
6	142.5[a]	132.6	93.8	69.0	89.7	89.7
8	211.5	207.4	203.7	193.8	184.1	191.2
10	307.2	298.8	384.2	374.5	339.4	367.7
12	312.7	369.1	484.4	485.0	417.0	477.0
14	330.7	417.6	449.0	548.6	525.8	472.7
16	376.7	341.1	516.9	532.9	499.2	537.0
18	213.1	205.1	234.8	223.9	238.1	248.0
LSD (0.05)	62.7					

[a] Values represent an average of 1990 and 1991.

Table 3.3. **Soybean dry weight as influenced by duration of wild poinsettia interference and distance from the weed within the soybean row in Baton Rouge, LA.**

Weeks of interference	Distance (cm)					
	0-10	10-20	20-40	40-60	60-80	80-100
	(g)					
6	32.3[a]	30.9	20.1	14.2	19.3	18.8
8	53.4	54.4	51.7	49.3	47.1	49.2
10	74.9	72.5	91.4	89.3	82.8	89.1
12	81.8	97.0	128.2	131.3	117.7	131.6
14	95.3	116.2	129.5	155.8	150.6	135.6
16	111.6	103.2	166.0	171.4	157.3	168.0
18	78.1	81.2	112.0	108.1	115.1	119.8
LSD (0.05)	16.4					

[a] Values represent an average of 1990 and 1991.

yield of soybean growing within 10 cm of the weed was less than yields for distances greater than 10 cm. Yields within 10 cm were reduced 9.5 and 18.0% when compared with the 20 to 40 cm and 80 to 100 cm distances, respectively. The 9.5% soybean yield reduction is comparable to that noted in soybean growing within 25 cm of common cocklebur and Palmer amaranth, within 12.5 cm of tall morningglory (3.11), and within 50 cm of jimsonweed (3.7). Sicklepod and johnsongrass had no adverse effect on soybean yield (3.11). In other studies, sicklepod decreased yields 12 to 26% over 2 m of row (3.14) whereas jimsonweed reduced yields 12% over 1.2 m (3.7). Differences in yields in the present study could not be attributed to 100-seed weight, which did not differ (data not shown).

Interference of wild poinsettia by soybean increased weed height 14% (69.0 to 78.5 cm). This effect is commonly observed as plants elongate due to lack of light. Wild poinsettia plant widths, when growing within the soybean row or alone, were similar at 2 and 4 wk (1990) and 2, 4, and 6 wk (1991) of interference, but thereafter plant width was greater with no interference (Table 3.5). Growth rate of wild poinsettia was greater in 1991 than in 1990. Season long competition of wild poinsettia with soybean reduced weed growth 67 and 59% in 1990 and 1991, respectively. In contrast, jimsonweed size was reduced 80 to 93% when in competition with soybean (3.7). Differences

Table 3.4. **Soybean yield as influenced by distance from the weed within the soybean row in Baton Rouge, LA.**

Distance	1990	1991
(cm)	(g)	
0-10	48.8	44.6
10-20	50.7	48.4
20-40	50.4	49.8
40-60	54.0	54.4
60-80	54.7	53.0
80-100	53.9	54.4
LSD (0.05)	3.7	

Table 3.5. **Wild poinsettia width within the soybean row or alone (no interference) as influenced by duration of interference in Baton Rouge, LA.**

Weeks of interference	1990		1991	
	Interference	No interference	Interference	No interference
	(cm)			
2	11.2	12.5	6.8	7.1
4	18.3	24.0	23.3	26.0
6	21.5	40.8	21.7	38.0
8	22.6	70.2	39.3	72.6
10	18.5	76.0	45.9	118.7
12	36.6	94.3	56.9	122.7
14	40.0	106.6	59.3	156.7
16	49.0	100.0	58.7	147.3
18	34.0	103.0	56.3	137.4
LSD (0.05)	6.9		18.9	

in wild poinsettia fresh weight between plants growing within the soybean row and alone occurred after 6 and 8 wk of interference in 1990 and 1991, respectively (Table 3.6). Fresh weight reduction averaged 81% in 1990 and 83% in 1992. Wild poinsettia dry weight followed the same response noted for fresh weight with differences between weeds growing within the soybean row and alone beginning at 8 wk in 1990 and 10 wk in 1991 (Table 3.7). Dry weight of wild poinsettia was reduced an average of 77% in 1990 and 82% in 1991 when growing in competition with soybean. In comparison, Monks (3.11) reported weed biomass reductions due to soybean competition of 90 to 97% with common cocklebur, johnsongrass, Palmer amaranth, sicklepod, and tall morningglory. A 92% reduction in jimsonweed biomass resulting from soybean competition has been observed (3.7).

Weeds were much larger in 1991 than in 1990 possibly because rainfall from May through September was twice that of 1990. Wild poinsettia dry weight biomass with no crop interference averaged 41 g in 1990 and 118 g in 1991, a 188% increase (Table 3.7). This difference in weed size indicates that environmental conditions in 1991 compared with the previous year were more conducive to weed growth and subsequent interference with the crop. This variation in weed growth could also explain why an 18% reduction in soybean yield within 10 cm of the weed occurred in 1991 whereas only a 9.4% loss was noted in 1990.

Table 3.6. **Wild poinsettia fresh weights within the soybean row or alone (no interference) as influenced by duration of interference in Baton Rouge, LA.**

Weeks of interference	1990		1991	
	Interference	No interference	Interference	No interference
	(g)			
2			0.3	0.4
4			8.7	13.3
6	8.4	38.2	8.8	27.1
8	15.4	134.0	34.1	119.1
10	24.8	210.5	52.9	417.1
12	61.5	278.7	176.8	872.5
14	62.4	263.5	166.5	950.9
16	88.1	280.8	174.9	948.6
18	40.3	254.4	149.8	975.8
LSD (0.05)	77.2		145.5	

Table 3.7. **Wild poinsettia dry weight within the soybean row or alone (no interference) as influenced by duration of interference in Baton Rouge, LA.**

Weeks of interference	1990		1991	
	Interference	No interference	Interference	No interference
	(g)			
2	0.1	0.1	0.1	0.1
4	0.8	1.2	1.2	2.6
6	1.4	7.1	1.7	5.8
8	3.6	29.3	5.7	23.5
10	6.1	44.0	10.4	75.5
12	19.7	76.4	46.4	221.9
14	18.0	67.2	43.8	241.0
16	26.7	71.7	45.6	247.9
18	14.4	70.4	42.1	242.5
LSD (0.05)	16.7		43.2	

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CHAPTER 4

INFLUENCE OF DENSITY AND DURATION OF INTERFERENCE OF WILD POINSETTIA IN SOYBEAN

INTRODUCTION

The magnitude of crop yield loss due to weed interference can be dependent on weed density, time of weed interference, and specific characteristics of both the weed and crop. Data collected from weed density and duration of interference studies determine the density and the time of competition needed to negatively impact crop growth and yield. This information is useful in determining weed threshold levels and effective weed control programs (4.25).

Density and duration of interference studies have been conducted in soybean with cocklebur (*Xanthium strumarium* L.) (4.2, 4.3), tall morningglory (*Ipomoea purpurea* (L.) Roth) (4.26, 4.32), ivyleaf morningglory (*Ipomoea hederacea* (L.) Jacq.) (4.10, 4.32), velvetleaf (*Abutilon theophrasti* Medik.) (4.14), venice mallow (*Hibiscus trionum* L.) (4.11), jerusalem artichoke (*Helianthus tuberosus* L.) (4.33), jimsonweed (*Datura stramonium* L.) (4.18), ragweed (*Ambrosia artemisiifolia* L.) (4.9), sicklepod (*Cassia obtusifolia* L.) (4.29), pennsylvania smartweed (*Polygonum pensylvanicum* L.) (4.8), hemp sesbania (*Sesbania exaltata* (Raf.) Rybd. ex. A. W. Hill) (4.22), johnsongrass (*Sorghum halepense* (L.)

Pers.) (4.31), and quackgrass (*Apropyron repens* (L.) Beauv.) (4.34). Regardless of the weed species, soybean can generally withstand competition for 4 to 8 wk after emergence before yield losses are observed (4.2, 4.8, 4.10, 4.11, 4.22, 4.26, 4.29, 4.31, 4.33). Weeds differ in their competitive ability with cocklebur being very competitive and grasses being less competitive (4.23). Johnsongrass and cocklebur reduced soybean yields 23 to 42% and 63 to 75%, respectively.

Wild poinsettia (*Euphorbia heterophylla* L.), an annual weed native to tropical and subtropical America (4.16), has become increasingly troublesome in the southeastern United States. In 1989, wild poinsettia, as a weed in soybean, was listed in the ten most troublesome weeds in Louisiana and Georgia and in the ten most common weeds in Louisiana (4.17, 4.27). Holm et al. (4.15) reported that wild poinsettia is: a serious weed in Fiji, Ghana, Mexico, and the Philippines; a principal weed in Cuba, Honduras, Italy, Peru, Uganda and the United States; and present as a weed in 29 other countries.

Wild poinsettia is a prolific seed producer with a single plant capable of producing 800 to 1500 seeds m^{-2} (4.12). A large potential plant population within a few growing seasons can occur. Seed germination of 95 to 100% has been observed in both field and laboratory experiments (4.12). Langston (4.19) reported 81% of seed buried at 5 cm produced seedlings during the following season. Brecke (4.4) observed 80% and 20% emergence of seeds planted at a 2 to 4 cm and 14 cm depths, respectively. Dense stands of 50 to 100 plants m^{-2} can result in severe competition with crops (4.12). Wild poinsettia often remains green at harvest and if high populations are present, soybean harvest may be completely inhibited (4.24).

Harger and Nester (4.13) reported soybean yield reductions of 18, 22, and 33% when 8 wild poinsettia plants per meter of row competed for 8 wk, 12 wk, or full season, respectively. A 16% and 50% reduction in soybean yield was noted when 54 plants m^{-2} competed for 45 and 115 d after soybean emergence, respectively (4.7). A 22% reduction occurred when 12 plants m^{-2} competed for 115 d. Langston (4.19) reported that when soybean were planted April 24 in southern Louisiana, 6 wk of weed-free maintenance were needed to obtain crop yields similar to the weed-free control. When soybean were planted on June 14, however, only 3 wk of weed-free maintenance were required indicating that weeds emerging later in the season are less competitive.

In peanuts, decreased yields of 107 kg ha^{-1} were observed for each wild poinsettia plant per 9.1 m of row (4.27). Peanut yield reductions were observed when wild poinsettia competed for longer than 8 wk and a 10 wk weed-free period was required to achieve yields similar to the weed-free check. In Georgia, 4 plants per 9.7 m of peanut row or higher reduced peanut yields (4.5). Yield losses of 30 to 50% were observed when 32 plants per 9.7 m of row were present. Yield losses occurred when wild poinsettia were present for more than 3 wk after peanut emergence and a 8 to 10 wk weed-free period was needed to avoid yield reductions. In contrast, Brown (4.6) reported that wild poinsettia control in peanuts for the first 10 wk can still result in a 20% yield reduction.

Even though substantial information is available on competition of wild poinsettia in peanuts, limited information is available on its competitiveness in soybean plants. Both density and duration of interference studies were conducted to determine the impact of varying wild poinsettia plant densities and time of interference on soybean growth and yield.

MATERIALS AND METHODS

Density Study. A field study was conducted in 1991 at Baton Rouge, LA on a Mhoon silty clay loam soil (fine-silty, mixed, nonacid, thermic Fluventic Haplaquepts). 'Asgrow 6785' soybean were planted in 76 cm row spacings on June 2, 1991 at a rate of 90 kg ha^{-1}. The higher than normal seeding rate was used and thinned to a uniform stand. After planting, the field was treated with 2.2 kg ha^{-1} of metolachlor for grass control. Wild poinsettia seed were planted in the greenhouse in peat pellets the same day soybean were planted in the field. After soybean emergence on June 10, weeds were transplanted within 5 cm of the soybean row at densities of 0, 4, 8, 16, 32, and 64 weeds per 6 m of row in the two center rows of each 4 row plot. Soybean stands were thinned to one plant per 2.5 cm of row on June 18. Weeds other than the planted wild poinsettia were hand removed during the entire season and plots were cultivated twice. Wild poinsettia plants at the various densities were allowed to compete full-season with the soybean.

Wild poinsettia plants within the two center rows were hand harvested on November 8 to determine fresh weights. Dry weights were determined by placing weeds in a dryer at 60°C until weight was constant. An earlier than normal freeze (min -1°C) on November 4 desiccated the weed foliage. Soybean were combine-harvested on November 12. Seed weight and moisture for individual plots were measured and yields were adjusted to 13% moisture.

A randomized complete block experimental design with four replications was used. Plots were 6 m long by 3 m wide. Data were subjected to analysis of variance and means were separated using Fisher's Protected LSD at the 5% probability level.

Duration of Interference Study. A field study was conducted in 1991 at Baton Rouge, LA on a Mhoon silty clay loam soil (fine-silty, mixed, nonacid, thermic Fluventic Haplaquepts). 'Asgrow 6785' soybean seed were planted in 76 cm row spacing on June 16, 1991 at a rate of 90 kg ha^{-1} to assure a uniform stand. A natural infestation of wild poinsettia (73 plants per meter of row) was present in the experimental area. Plots were treated with metolachlor at 2.8 kg ha^{-1} at planting and fluazifop-P at 0.2 kg ha^{-1} on July 11, 1991 for grass control. Plots were four rows wide (3 m) and 7.6 m long. The center rows were allowed to naturally infest with wild poinsettia and the border rows were maintained weed-free. Plots were cultivated twice during the season leaving a 30 cm uncultivated band and hand-hoed as required to remove weeds other than wild poinsettia. Wild poinsettia plants were removed at 0, 2, 4, 6, 8, 10, 14, and 18 wk after soybean emergence. At the time of removal, wild poinsettia densities, plant heights, canopy widths, fresh weights, and dry weights and soybean densities, plant heights, and canopy widths were determined on one meter of row randomly selected within the two center rows of each plot. Dry weights were determined as described previously. Plots were maintained weed-free from the time of weed removal until harvest.

Mature soybean plant height was measured and plots were combine-harvested. Total seed weight and percent moisture were measured for each plot, and yields were adjusted to 13% moisture.

A randomized complete block experimental design with four replications was used. Data were analyzed using analysis of variance and means were separated using Fisher's Protected LSD at the 5% level of probability.

RESULTS AND DISCUSSION

Density Study. Fresh weight biomass of wild poinsettia at soybean maturity increased for densities of 8 plants or more per 6 m of row compared with the weed-free control (Table 4.1). Fresh weights were similar for densities of 4 and 8 weeds per 6 m of row and for 16 and 32 plants per 6 m of row. When the density was increased to 64 plants per 6 m of row, weed fresh weight was more than 8 times greater than with 4 plants. Wild poinsettia dry weights followed a similar trend observed with fresh weights. Weed dry weights for the various densities averaged approximately 56% less than fresh weights, which was lower than expected, probably due to an early freeze on November 4 which desiccated the weed foliage. Weed dry weights, at plant densities of 4 and 8 per 6 m of row, were similar and greater than the weed-free control and continued to increase at densities of 16, 32, and 64 weeds per 6 m of row.

Compared with the weed-free check, soybean yields were reduced at weed densities of 8 plants or more per 6 m of row and ranged from 17 to 41% (Table 4.1). At densities of

Table 4.1. **Wild poinsettia biomass accumulation and soybean yield as influenced by varying weed densities in Baton Rouge, LA in 1991.**

Wild poinsettia density	Wild poinsettia		Soybean yield[a]
# (6 m row)$^{-1}$	fresh wt. (g/plot)	dry wt. (g/plot)	(kg ha^{-1})
0	0	0	4610 (0)
4	1340	590	3930 (15)
8	2820	1130	3820 (17)
16	6870	3210	3470 (25)
32	8490	3800	2710 (41)
64	10960	4600	2710 (41)
LSD (0.05)	1780	540	700

[a] Values in parentheses represent percent reduction in yield compared with the weed-free check.

4, 8, and 16 wild poinsettia plants per 6 m of row, soybean seed yields were similar and were reduced from 15 to 25%. With 32 and 64 plants per 6 m of row, yield reductions were 41%.

Soybean seed moisture at harvest was not significantly affected by wild poinsettia density (data not shown). In a similar study, season-long competition of 8 wild poinsettia plants per meter of row (48 per 6 m of row) reduced soybean yields 33% (4.13), which is similar to the 41% reduction observed in the present study with 32 and 64 wild poinsettia per 6 m of row. Peanut yield reductions were observed with 4 or more plants per 9.7 m of row (2.5 or more plants per 6 m of row). Yield reductions of 30 to 50% were observed in peanuts when 32 plants per 9.7 m of row (20 plants per 6 m of row) were present (4.5). To obtain this same yield reduction at least 32 plants per 6 m of row were needed. These data indicate that soybean are more competitive with wild poinsettia than peanut. The early season slow growth of peanuts compared with soybean could account for the lower degree of competitiveness.

Duration of Interference Study. Wild poinsettia height increased from 14.3 cm at 2 wk to 139.3 cm at 18 wk and exceeded soybean height beginning at 8 wk (Table 4.2). By 10 wk after emergence, wild poinsettia height averaged 44.5 cm more than soybean. Weed width increased from 15.3 cm at 2 wk to 40.5 cm at 18 wk and like weed heights, are

Table 4.2. **Wild poinsettia and soybean growth characteristics and soybean yield as influenced by duration of weed interference in Baton Rouge, LA in 1991.**

Duration of interference	Wild poinsettia			Soybean		
	height	width	dry wt.	height	width	yield[a]
weeks	(cm)		(g/plot)	(cm)		(kg ha^{-1})
0	-	-	-	-	-	2740 (0)
2	14.3	17.3	10.2	16.3	21.3	2682 (2)
4	24.5	15.3	15.2	27.5	29.0	2605 (5)
6	39.0	19.5	23.2	41.3	52.0	2504 (9)
8	67.8	24.0	51.2	63.3	49.8	2475 (10)
10	107.3	22.8	152.2	62.8	64.8	2025 (26)
14	128.5	40.5	144.9	72.3	56.5	1651 (40)
18	139.3	34.0	186.7	63.0	12.3	1660 (39)
LSD (0.05)	12.7	10.2	61.1	8.7	10.9	632

[a] Values in parentheses represent percent reduction in yield compared with the weed-free check.

reflective of weed growth. Wild poinsettia dry weight increased from 10.2 g at 2 wk after emergence to 187.6 g at 18 wk.

At harvest, soybean plant height and percent moisture were not affected by wild poinsettia interference (data not shown). The potential increase in moisture associated with weed presence was not a factor in this study since weeds were removed at the specific timings and consequently were not present at crop harvest.

Wild poinsettia competition for 8 wk did not significantly reduce soybean yields compared with the weed-free check (Table 4.2). Ten weeks of interference, however, reduced yields 26% when compared with the weed-free check but yields were comparable to 2, 4, 6, and 8 wk of interference. Wild poinsettia interference for 10, 14, and 18 wk reduced yields similarly, ranging from 26 to 40%. These data indicate that if wild poinsettia is removed within 8 wk after interference, yields are not significantly reduced, but at 10 wk of interference a 26% reduction in yield was observed. In other studies, weed removal within 4 to 8 wk resulted in optimum yields (4.2, 4.8, 4.10, 4.11, 4.22, 4.26, 4.29, 4.31, 4.33). Royal et al. (4.27) reported significant yield reductions if wild poinsettia competed with peanut longer than 8 wk. Bridges (4.5), however, observed yield losses when wild poinsettia competed for more than 3 wk after peanut emergence. The difference in response is not evident but would be dependent of the weed density and early season competitiveness of the peanut crop.

Wild poinsettia removal within 8 wk after emergence was necessary to avoid a significant yield reduction. A density of 8 wild poinsettia plants per 6 m of row reduced soybean yields 17%. In this study only yield differences were considered. The presence of wild poinsettia at densities of less than 8 plants per 6 m of row may not contribute to a significant yield reduction but may increase percent moisture and foreign material in the harvested seed (4.30) and consequently may be of economic importance (4.1, 4.20, 4.21).

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CHAPTER 5

SOYBEAN YIELD AND QUALITY RESPONSES ASSOCIATED WITH WILD POINSETTIA CONTROL PROGRAMS

INTRODUCTION

Weeds often decrease soybean quality by increasing moisture and foreign material; however, this added advantage of weed control is often overlooked. Anderson and McWhorter (5.1) and McWhorter and Anderson (5.7, 5.8) evaluated the effects of common cocklebur control levels on the grade components of soybean seed. Foreign material was 0.7% and 5.1% with total common cocklebur control and no control, respectively. Common cocklebur control of 70% or more was required to prevent deductions due to moisture in excess of 13%. A reduction in soybean quality can also economically impact the producer by decreasing the price received per bushel.

Wild poinsettia (*Euphorbia heterophylla* L.), a native plant of tropical and subtropical America (5.6), is found throughout the southeastern United States and continues to increase in severity. Wild poinsettia is capable of prolific seed production resulting in high weed populations that can preclude soybean harvest. Wild poinsettia remains green at harvest, and the plants contain a white latex sap that can interfere with harvesting efficiency and increase the moisture content of the harvested seed (5.5).

Herbicidal control of wild poinsettia is often inadequate (5.12), and weeds exceeding 10 cm in height are difficult to control (5.9). Preemergence (PRE) treatments have provided varying levels of wild poinsettia control with clomazone being excellent (5.4), metribuzin from 10 to 100% but primarily 60 to 70%, (5.2, 5.3, 5.9, 5.11), linuron 50 to 60% (5.2, 5.11), alachlor 40 to 50% (5.2), and imazaquin 70 to 80% (5.3, 5.4). Metribuzin plus chlorimuron provided poor control of wild poinsettia.

Wild poinsettia control is generally better when postemergence (POST) herbicides are used (5.2, 5.3, 5.4, 5.5, 5.9, 5.10). Bentazon, acifluorfen, imazaquin, chlorimuron, fomesafen, and lactofen applied POST have all controlled at least 90% of wild poinsettia. PRE followed by POST herbicides have also provided favorable control of wild poinsettia. Greater than 90% control was achieved with the following PRE/POST combinations: imazaquin/imazaquin (5.3, 5.4), or metribuzin plus chlorimuron/chlorimuron (5.4).

Studies were conducted over two years to investigate the impact of PRE and POST combinations on wild poinsettia control, soybean yield, and crop quality parameters of moisture and foreign material.

MATERIALS AND METHODS

Field studies were conducted in 1990 and 1991 at the Ben Hur Research Farm in Baton Rouge, LA on a Mhoon silty clay loam soil (fine-silty, mixed, nonacid, thermic Fluventic Haplaquepts). 'Asgrow 6785' soybean seed were planted on May 18, 1990 and June 16, 1991 into an area with a natural infestation of wild poinsettia. Plots were four rows spaced 76 cm apart and 7.6 m long, and the two center rows were treated. Metolachlor at 2.2 kg ha^{-1} was applied at planting both years and fluazifop-P at 0.2 kg ha^{-1} was applied July 11, 1991 to maintain grass control. Plots were cultivated twice and hoed throughout the season to insure a weed population of only wild poinsettia.

Clomazone (1.12 kg ha^{-1}), imazaquin (0.14 kg ha^{-1}), metribuzin (0.63 kg ha^{-1}), and metribuzin plus chlorimuron (0.54 + 0.09 kg ha^{-1}) were applied PRE to the soil surface immediately after planting. Chlorimuron (0.009 kg ha^{-1}), imazaquin (0.14 kg ha^{-1}), fomesafen (0.42 kg ha^{-1}), acifluorfen (0.56 kg ha^{-1}), and no herbicide were applied POST when the largest wild poinsettia were 7.6 cm in height. Due to multiple weed flushes size ranged from 2.5 to 7.6 cm. A nonionic surfactant[1] at 0.25% (v/v) was added

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[1]X-77 Spreader (alkylarylpolyoxyethylene, glycols, free fatty acids, isopropanol) Valent USA Corp., 1333 N. California Blvd., Walnut Creek, CA 94596-8025.

to all POST treatments. An untreated check was also included for comparison. All herbicide treatments were applied in 140 L ha^{-1} at 207 kPa. Rainfall of 10.6 cm in 1990 and 13.7 cm in 1991 was received within 14 days of PRE applications.

Visual weed control ratings based on a scale of 0%=no control and 100%=complete death were made 28 days after PRE applications and 14 days after POST applications. Soybean yields, adjusted to 13% moisture, were determined after combine-harvesting the two treated rows of each plot on November 1, 1990 and November 7, 1991. The total seed collected from each plot were weighed, dried, reweighed, cleaned, and reweighed to determine percent moisture and foreign material.

The experimental design was a factorial arrangement of treatments (four PRE and five POST treatments) along with an untreated check in a randomized complete block with four replications. Data were subjected to analysis of variance, and means were separated using Fisher's Protected LSD at the 5% level of probability.

RESULTS AND DISCUSSIONS

Wild poinsettia control 28 days after application of PRE treatments was similar for clomazone, imazaquin, and metribuzin plus chlorimuron both years and was at least 87% (data not shown). Excellent control of wild poinsettia with clomazone and approximately 70% control with imazaquin have been observed (5.3, 5.4). Weed control with metribuzin applied alone in the present studies was lower than the other PRE treatments being 78% in 1990 and only 50% in 1991 when 9.3 cm of rain was received between 1 and 3 days after treatment. Bannon et al. (5.2), Griffin et al. (5.3), and Vidrine et al. (5.11) have observed 60 to 70% wild poinsettia control with metribuzin.

At 14 days after the POST applications (which corresponded to approximately 40 days after PRE applications), wild poinsettia control, averaged across years, was only 38% for metribuzin which was significantly lower than other treatments (Table 5.1). When herbicides were applied alone, control was approximately 70% for clomazone or metribuzin plus chlorimuron but was 86% for imazaquin. Applications of chlorimuron, imazaquin, fomesafen, or acifluorfen POST following clomazone, metribuzin, or metribuzin plus chlorimuron PRE averaged across years increased wild poinsettia control when compared with the PRE treatments alone. When POST treatments followed imazaquin, however, weed control was not improved over that of imazaquin PRE alone. When metribuzin was applied PRE, sequential applications of imazaquin, fomesafen, or acifluorfen POST provided greater wild poinsettia control (89 to 95%) compared with chlorimuron (77%). Wild poinsettia control with the

Table 5.1. **Wild poinsettia control following preemergence (PRE) and postemergence (POST) herbicide treatments in Baton Rouge, LA.[a]**

		POST herbicide (kg ha^{-1})				
PRE herbicide	Rate	None	Chlorimuron (0.009)	Imazaquin (0.14)	Fomesafen (0.42)	Acifluorfen (0.56)
	(kg ha^{-1})	(%)				
Clomazone	1.12	71[b]	95	91	94	95
Imazaquin	0.14	86	93	91	95	93
Metribuzin	0.63	38	77	95	89	93
Metribuzin + Chlorimuron	0.54 0.09	70	93	92	89	92
LSD (0.05)		9				

[a] Ratings made 14 days following POST application.
[b] Values represent an averaged for 1990 and 1991.

sequential POST applications following PRE treatments was similar to results observed in earlier studies in which 80 to 98% of wild poinsettia was controlled with imazaquin followed by imazaquin, or metribuzin plus chlorimuron followed by chlorimuron (5.3).

All herbicide treatments in 1990 resulted in soybean seed yields greater than the untreated check (Table 5.2). Even though variations in weed control among the herbicide treatments were observed (Table 5.1), PRE herbicides applied alone generally provided sufficient wild poinsettia control to prevent soybean yield reductions. With the exception of imazaquin following clomazone or metribuzin, yields were not enhanced with application of POST treatments. In 1991, yields were similar whether PRE herbicides were applied alone or followed by POST treatments (Table 5.3). Yields averaged 43% lower in 1991 than in 1990. The lower yields were probably related to the later planting date in 1991 and rainfall from May through September, which was twice that of the previous year.

Even though yields for the herbicide treatments were generally similar, differences in quality parameters related to weed control were evident. Averaged across the PRE treatments in 1990, applications of chlorimuron, imazaquin, fomesafen, or acifluorfen POST significantly reduced percent moisture when compared with a PRE treatment

Table 5.2. **Soybean yield following preemergence (PRE) and postemergence (POST) herbicide treatments in Baton Rouge, LA in 1990.**

PRE herbicide	Rate (kg ha^{-1})	POST herbicide (kg ha^{-1})				
		None	Chlorimuron (0.009)	Imazaquin (0.14)	Fomesafen (0.42)	Acifluorfen (0.56)
		(kg ha^{-1})				
Clomazone	1.12	3500	3800	4180	3890	3980
Imazaquin	0.14	3980	4100	3880	3940	3730
Metribuzin	0.63	3370	3790	3990	3730	3640
Metribuzin + Chlorimuron	0.54 0.09	3610	4030	3820	3850	4045
Untreated check		2020				
LSD (0.05)		600				

Table 5.3. **Soybean yield following preemergence (PRE) and postemergence (POST) herbicide treatments in Baton Rouge, LA in 1991.**

PRE herbicide	Rate (kg ha^{-1})	POST herbicide (kg ha^{-1})				
		None	Chlorimuron (0.009)	Imazaquin (0.14)	Fomesafen (0.42)	Acifluorfen (0.56)
		(kg ha^{-1})				
Clomazone	1.12	1870	2240	1950	1870	2040
Imazaquin	0.14	2500	1800	2680	2530	2250
Metribuzin	0.63	1600	2240	2220	2340	2000
Metribuzin + Chlorimuron	0.54 0.09	2000	2000	2440	2460	2310
Untreated check		1150				
LSD (0.05)		NS				

Table 5.4. **Percent moisture and foreign material in harvested soybean seed averaged across the preemergence treatments in Baton Rouge, LA.**

POST herbicide	Rate	Seed moisture		Foreign material[a]
		1990	1991	
	(kg ha^{-1})	(%)		
None		11.2	9.4	3.5
Chlorimuron	0.009	7.0	9.3	2.5
Imazaquin	0.14	8.7	9.8	2.6
Fomesafen	0.42	8.5	8.8	2.6
Acifluorfen	0.56	7.3	9.5	2.0
LSD (0.05)		1.7	NS	0.8

[a] Values represent an average for 1990 and 1991.

alone (11.2%) (Table 5.4). In 1990, percent moisture was lower for chlorimuron than with imazaquin but was similar to the other POST treatments. For comparison, percent moisture for the untreated check was 21.6%. In contrast, in 1991 differences among the treatments were not detected, and percent moisture ranged from 8.8 to 9.8%. The moisture content of the untreated check that year was 10.3%. The similarity in percent moisture was due to an earlier than normal freeze (min -1°C) on November 4 which desiccated the wild poinsettia.

When averaged across years, percent foreign material for PRE treatments applied alone was 3.5% and was significantly reduced when additional POST treatments were applied (Table 5.4). For comparison, the untreated check was 6.2%. Even though an early freeze in 1991 reduced moisture, desiccated weed stems and foliage were still present at harvest which contributed to increased foreign material.

In these studies, foreign material was reduced when the POST treatments were applied following PRE treatments even though yields were generally not affected. In marketing soybean, in most cases, foreign material in excess of 1% is deducted from the gross weight of seed delivered to the elevator. This deduction would result in a reduction in net returns to the producer.

From an economic perspective, applications of POST treatments following PRE treatments for wild poinsettia control generally did not increase yield and therefore would not be considered cost effective. However, applications of POST treatments following PRE treatments reduced foreign material content both years and moisture when an early freeze was not obtained. The impact of increased moisture and foreign material on grade reduction and net returns should be considered when wild poinsettia is not controlled adequately.

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CHAPTER 6

WILD POINSETTIA AND SOYBEAN RESPONSES TO TIMING OF FOLIAR APPLIED HERBICIDES

INTRODUCTION

Wild poinsettia (*Euphorbia heterophylla* L.), a native plant of tropical and subtropical America (6.3), is found throughout the southeastern United States and continues to increase in severity. Wild poinsettia has become especially troublesome in row crops in southern Louisiana. The weed is capable of abundant seed production and can become yield limiting under high plant populations (6.2). Unlike many weeds that are desiccated at soybean harvest, wild poinsettia stems remain green and contain white latex sap which can interfere with harvesting efficiency. Resulting increases in moisture and foreign material content of harvested seed can decrease crop quality (6.2). These potential quality reductions have a negative economic impact on the producer by decreasing market price of the crop.

Herbicidal control of wild poinsettia has often been inadequate (6.9). In fact, after the weed exceeds 10 cm, it becomes more difficult to control (6.8). Harger and Nester (6.2) reported greater control with bentazon and acifluorfen applied to wild poinsettia 8 cm in height compared with 15 cm. When herbicides are applied to large weeds and control is inadequate, weed regrowth from lower nodes is common (6.4, 6.5).

Anderson and McWhorter (6.1) and McWhorter and Anderson (6.6, 6.7) evaluated grade components of harvested soybean as influenced by common cocklebur control levels that are often overlooked when considering economic advantages from weed control. Foreign material was increased from 0.7% with complete common cocklebur control to 5.1% with no weed control. Common cocklebur control of 70% or more was required to prevent deductions due to moisture in excess of 13%.

Studies were conducted over two years to investigate wild poinsettia control following early postemergence and late postemergence herbicide applications. The impact of time of herbicide application on soybean yield and seed quality parameters of moisture and foreign material was investigated.

MATERIALS AND METHODS

Field studies were conducted at the Ben Hur Research Farm in Baton Rouge, LA on a Mhoon silty clay loam soil (fine-silty, mixed, nonacid, thermic Fluventic Haplaquepts). 'Asgrow 6785' soybean seed were planted on May 18, 1990 and June 16, 1991 in an area naturally infested with wild poinsettia. Planting in 1991 was delayed due to excessive rainfall in May. Plots were four rows spaced 76 cm apart and 7.6 m long. Metolachlor preemergence at 2.2 kg ha^{-1} and fluazifop-P postemergence at 0.2 kg ha^{-1} were applied for annual grass control. Plots were hand-hoed full season to remove weeds other than wild poinsettia and were cultivated twice.

Fomesafen (0.42 kg ha^{-1}), imazaquin (0.14 kg ha^{-1}), acifluorfen (0.42 kg ha^{-1}), lactofen (0.22 kg ha^{-1}), and chlorimuron (0.009 kg ha^{-1}) were applied to the two center rows of designated plots at early postemergence (EPOST) when wild poinsettia was 2 to 8 cm and at late postemergence (LPOST) when wild poinsettia was 10 to 15 cm. For comparisons, weed-free and untreated checks were included. A nonionic surfactant[2] at 0.25% (v/v) was added to all herbicide treatments, and applications were made in 140 L ha^{-1} at 180 to 210 kPa.

Visual weed control ratings based on a scale of 0%=no control and 100%=complete death were made 14 days after treatment (DAT). Soybean seed yields, adjusted to 13% moisture, were determined after combine-harvesting the two treated rows of each plot. The soybean seed were harvested on November 1, 1990 and November 7, 1991. The seed collected from each plot were weighed, dried, reweighed,

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[2]X-77 Spreader (alkylarylpolyoxyethylene, glycols, free fatty acids, isopropanol) Valent USA Corp., 1333 N. California Blvd., Walnut Creek, CA 94596-8025.

cleaned, and reweighed to allow for calculations of percent moisture and foreign material. Soybean yields were based on cleaned seed weights.

The experimental design was a factorial arrangement of treatments (two timings and five herbicides) in a randomized complete block with four replications. Data were subjected to analysis of variance for individual years and across years, and means were separated using Fisher's Protected LSD at the 5% level of probability.

RESULTS AND DISCUSSION

In 1990, 95% wild poinsettia control was obtained 14 DAT with early applications of fomesafen, imazaquin, acifluorfen, lactofen, or chlorimuron (Table 6.1). For all herbicides, LPOST applications gave lower weed control when compared with EPOST. Chlorimuron applied LPOST in 1990 provided greater control (84%) than the other treatments when control was no higher than 41%. With the exception of chlorimuron, wild poinsettia control in 1991 was comparable for EPOST and LPOST. When applied EPOST and LPOST, wild poinsettia control with fomesafen, acifluorfen, and lactofen was similar and at least 91%. Control with imazaquin LPOST was 78%. Rainfall in 1991 was twice that received in 1990 and may explain why larger, faster-growing weeds were easier to control the second year.

Table 6.1. **Wild poinsettia control 14 days after treatment as influenced by early (EPOST) and late postemergence (LPOST) herbicide applications in Baton Rouge, LA.**

		1990		1991	
	Rate	EPOST	LPOST	EPOST	LPOST
Herbicide	(kg ha^{-1})	(%)			
Fomesafen	0.42	95	28	93	95
Imazaquin	0.14	95	40	81	78
Acifluorfen	0.42	95	28	91	95
Lactofen	0.22	95	41	91	94
Chlorimuron	0.009	95	84	83	95
Weed-free check		100	-	100	-
Untreated check		0	-	0	-
LSD (0.05)		11			

In 1990, Harger and Nester (6.2) noted decreased weed control with acifluorfen applied to larger wild poinsettia. Acifluorfen applied at 0.28 or 0.56 kg ha^{-1} to weeds 15 cm in height controlled 60 and 85% of wild poinsettia, respectively. Weed control improved to 80 and 95% when acifluorfen at 0.28 or 0.56 kg ha^{-1}, respectively, was applied to 8 cm tall wild poinsettia.

In 1990, EPOST applications of fomesafen or acifluorfen resulted in increased yields compared with late applications. Even though weed control was reduced when imazaquin, lactofen, or chlorimuron was applied LPOST (Table 6.1), yields were similar regardless of timing (Table 6.2). Soybean seed yields in herbicide treated plots, applied EPOST or LPOST, were at least 55% greater than those from the untreated check. In 1991, even though weed control was good to excellent for all herbicide treatments regardless of application time (Table 6.1), soybean yields were similar to the untreated check. The similarity in yields may be related to excessive rainfall immediately after planting that caused some soybean stand loss. Weed competition studies conducted that year indicated that weed growth, however, was not hindered under these conditions.

Percent foreign material for EPOST applications in 1990 was similar for fomesafen, imazaquin, acifluorfen, and lactofen and was less than that observed for chlorimuron

Table 6.2. **Soybean yield as influenced by early (EPOST) and late postemergence (LPOST) herbicide applications in Baton Rouge, LA.**

		1990		1991	
	Rate	EPOST	LPOST	EPOST	LPOST
Herbicide	(kg ha^{-1})	(kg ha^{-1})			
Fomesafen	0.42	3170	2430	1620	1770
Imazaquin	0.14	2560	2910	1710	1720
Acifluorfen	0.42	2990	2140	1490	1870
Lactofen	0.22	2370	2160	1610	1690
Chlorimuron	0.009	2380	2620	1510	1660
Weed-free check		2780	-	1620	-
Untreated check		1380	-	1440	-
LSD (0.05)		540			

(Table 6.3). Early postemergence applications of acifluorfen or lactofen resulted in less foreign material than the LPOST applications, and foreign material was similar regardless of timing for fomesafen, imazaquin or chlorimuron. Percent foreign material for all herbicide treatments was reduced by at least 33% compared with the untreated check. Differences in foreign material among the treatments were not detected in 1991. This can be attributed to an early freeze (min -1°C) on November 4 which desiccated the weeds prior to harvest and allowed more efficient removal of trash by the combine.

In 1990, with the exception of chlorimuron, EPOST herbicide applications decreased percent moisture in the harvested samples when compared with LPOST (Table 6.4). Moisture was decreased at least 34 and 25% compared with the untreated check for EPOST or LPOST applications, respectively. In contrast, in 1991 with the exception of imazaquin applied EPOST or LPOST, percent moisture was similar to the untreated check. The similarity in moisture in 1991 was probably related to the early freeze.

Early postemergence applications of fomesafen, imazaquin, acifluorfen, lactofen, or chlorimuron resulted in excellent and generally comparable weed control both years. Late postemergence herbicide applications, however, did not always result in reduced wild poinsettia control. When weed control was reduced by delayed herbicide

Table 6.3. **Percent foreign material in combine-harvested soybean seed as influenced by early (EPOST) and late postemergence (LPOST) herbicide applications in Baton Rouge, LA.**

		1990		1991	
	Rate	EPOST	LPOST	EPOST	LPOST
Herbicide	(kg ha^{-1})	(%)			
Fomesafen	0.42	4.5	5.5	2.0	1.6
Imazaquin	0.14	2.4	4.1	2.4	2.5
Acifluorfen	0.42	4.5	7.8	2.2	2.7
Lactofen	0.22	3.9	6.8	1.6	0.8
Chlorimuron	0.009	8.1	7.6	2.2	2.6
Weed-free check		6.5	-	3.9	-
Untreated check		12.0	-	1.7	-
LSD (0.05)		2.8			

Table 6.4. **Percent moisture of combine-harvested soybean seed as influenced by early (EPOST) and late postemergence (LPOST) herbicide applications in Baton Rouge, LA.**

		1990		1991	
	Rate	EPOST	LPOST	EPOST	LPOST
Herbicide	(kg ha^{-1})	(%)			
Fomesafen	0.42	11.8	19.1	10.8	10.6
Imazaquin	0.14	10.1	14.8	8.2	8.2
Acifluorfen	0.42	14.2	20.4	11.7	9.2
Lactofen	0.22	14.9	20.7	10.7	9.9
Chlorimuron	0.009	18.1	15.8	11.2	9.4
Weed-free check		16.9	-	9.4	-
Untreated check		27.6	-	13.1	-
LSD (0.05)		4.1			

application, percent foreign material and moisture increased significantly. Crop quality improvements as a consequence of timely herbicide application should not be overlooked when considering the economic advantages of postemergence weed control programs for wild poinsettia.

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CHAPTER 7

GROWTH RESPONSE OF WILD POINSETTIA FOLLOWING FOLIAR HERBICIDE APPLICATIONS

INTRODUCTION

Wild poinsettia, a native plant of tropical and subtropical America (7.2), is found throughout the southeastern United States and continues to increase in agronomic importance. Wild poinsettia has become a problem in southern Louisiana and high populations can prevent soybean harvest (7.5).

Herbicidal control of wild poinsettia has often been inadequate (7.8), and as the weed exceeds 10 cm in height, control becomes more difficult (7.5). Harger and Nester (7.1) reported increased control with bentazon and acifluorfen when applied to wild poinsettia at 7.5 cm compared with 15 cm.

It is common for wild poinsettia to regrow from lower nodes and produce seeds when herbicides are applied to large weeds and control is ineffective. Wild poinsettia, in studies in Florida, survived salvage treatments of paraquat post-directed in soybean at early bloom stage, and regrowth occurred from nodes below the area girdled by the herbicide (7.3).

Langston et al. (7.4) also noted the production of adventitious shoots from wild poinsettia following herbicide applications. They concluded that adventitious regrowth is a mechanism which may contribute to tolerance of wild poinsettia to contact herbicide treatments.

Since application timing is critical to weed control with herbicide treatments and may influence regrowth common in wild poinsettia, studies were conducted to evaluate growth response to various herbicides and application timings. Treated weeds were monitored to evaluate the effects of herbicides on growth and subsequent flower production, seed development, and biomass accumulation.

MATERIALS AND METHODS

Studies were conducted in the greenhouse and in the field in Baton Rouge, LA to assess the response of wild poinsettia to time of application of imazaquin (0.14 kg ha^{-1}), fomesafen and acifluorfen (0.42 kg ha^{-1}), and chlorimuron (0.009 kg ha^{-1}).

Greenhouse Studies. Wild poinsettia seeds were planted in the greenhouse on February 15, 1991 and January 10, 1992 and thinned to one plant per pot after emergence. Mechanical treatments, including removal of plant tissue just above the cotyledonary node and at the soil level, along with untreated checks were included for comparison to the herbicide treatments. Treatments were imposed when wild poinsettia was 5 to 7 cm (POST1), 8 to 10 cm (POST2), and 15 to 20 cm (POST3) in height. A nonionic surfactant[3] at 0.25% (v/v) was added to herbicide treatments. Applications were made in 190 L ha^{-1} at 210 kPa.

Visual control ratings, based on a scale of 0%=no injury and 100%=complete death, were made at 7 and 14 days after treatment (DAT). Weed heights were measured 14 and 28 DAT. At 28 DAT, lateral branches were counted and plants were harvested for biomass. Harvested weeds were placed in a dryer at 60°C until weights were constant and dry weights recorded.

The experimental design was a randomized complete block with a factorial arrangement of treatments (seven treatments and three timings) with five replications. Data were analyzed across studies, and all interactions were tested for significance. Data are presented in tables according to significant interactions. Data were subjected to analysis of variance, and means were separated using Fisher's Protected LSD at the 5% level of probability.

Field Study. A field study was conducted in 1991 at the Ben Hur Research Farm in an area naturally infested by wild poinsettia to further delineate weed response to herbicide application. In contrast to the greenhouse studies, the

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[3]X-77 Spreader (alkylarylpolyoxyethylene, glycols, free fatty acids, isopropanol) Valent USA Corp., 1333 N. California Blvd., Walnut Creek, CA 94596-8025.

field study would further allow for determination of herbicidal effects on seed production and residual activity. A Mhoon silty clay loam soil (fine-silty, mixed, nonacid, thermic Fluventic Haplaquepts) was treated with metolachlor at 2.2 kg ha^{-1} on June 3 to control annual grasses. Plots were 61 by 61 cm square and were maintained weed-free except for the wild poinsettia.

Imazaquin, fomesafen, acifluorfen, or chlorimuron at the same rates and at the same growth stages used in the greenhouse studies, were applied to wild poinsettia. An untreated check was included for comparison. A nonionic surfactant at 0.25% (v/v) was added to herbicide treatments. Applications were made at 140 L ha^{-1} at 180 to 210 kPa.

Three wild poinsettia plants within each plot were marked with tags at the beginning of the experiment. Data were taken on these three plants at intervals throughout the growing season. Wild poinsettia control ratings on the scale previously described were made 14 DAT. Weed height was determined 28 DAT and at flowering on August 29.

The total number of wild poinsettia plants per plot were counted the day of herbicide treatment, 14 and 28 DAT, and at flowering. At 14 and 28 DAT, counts were subdivided into large and small wild poinsettia. Large wild poinsettia were plants above the 2-leaf stage which were present at the time of herbicide application, while small plants which emerged after application were from cotyledonary to 2-leaf. These data were collected to indicate the residual effect of the herbicide treatments as well as weed regrowth following application.

The number of secondary inflorescences (clusters of flowers) on the three plants were counted to estimate seed production. This estimation was performed because of the difficulty associated with collecting wild poinsettia seeds dispersed by dehiscence. Ten randomly selected plants in flower on August 29 were used to obtain an average number of inflorescences (cyathia) produced within each secondary inflorescence. Using this average number of cyathia (48.1), the number of locules within each cyathium (3), the number of secondary inflorescences per plant in each plot, and the number of plants in each plot, an estimate of seed production per plot was made. Weeds from the entire plot were harvested on October 17 and were placed in a dryer at 60°C. Dry weights were recorded when weights were constant.

The experimental design was a randomized complete block with a factorial arrangement of treatments with four replications. Data were subjected to analysis of variance, and means were separated using Fisher's Protected LSD at the 5% level of probability.

RESULTS AND DISCUSSION

Greenhouse Studies. The mechanical removal of plant tissue at the soil level resulted in complete control with no subsequent regrowth. This treatment was included to assess regrowth potential and would be applicable when cultivation is used in a field situation. Removal of plant tissue just above the cotyledonary node, however, resulted in weed regrowth whereby axillary shoots were produced from the cotyledonary node (7.4). This treatment was included to simulate weed regrowth common when some herbicide treatments cause only localized injury and long-term control is often inadequate.

At 7 DAT wild poinsettia control was at least 94% for fomesafen, acifluorfen, and removal of weeds at the soil level at either POST1 or POST2 (Table 7.1). Imazaquin or chlorimuron controlled wild poinsettia at POST1 similarly, but control was no more than 84%. Weed control was poor (52 to 66%) when plant tissue just above the first node was removed mechanically for all application timings. Control by herbicides was significantly reduced when application was delayed until POST3.

Wild poinsettia control by fomesafen and acifluorfen applied at POST1 and POST2 (Table 7.1) remained excellent (at least 94%) 14 DAT. Imazaquin and chlorimuron applied at POST1 controlled 87 and 98% of wild poinsettia, respectively. Control with these treatments decreased to

Table 7.1. **Wild poinsettia control 7 and 14 DAT as influenced by time of postemergence (POST) herbicide application, and mechanical removal at ground level and just above the cotyledonary node in greenhouse studies.**

		Wild poinsettia control					
		7 DAT			14 DAT		
Treatment	Rate	POST1[a]	POST2	POST3	POST1	POST2	POST3
	(kg ha^{-1})	(%)					
Imazaquin	0.14	76	70	44	87	78	66
Fomesafen	0.42	95	94	73	99	94	77
Acifluorfen	0.42	96	95	76	96	94	79
Chlorimuron	0.009	84	81	55	98	91	87
Mech-ground	-	100	100	99	100	100	100
Mech-first node	-	60	66	52	43	58	63
Untreated check		0	0	0	0	0	0
LSD (0.05)		8			5		

[a] POST1 (5 to 7 cm), POST2 (8 to 10 cm), and POST3 (15 to 20 cm).

78 and 91%, respectively when treatments were applied at POST2. With the exception of chlorimuron, delaying herbicide application to POST3 decreased weed control compared with POST2. When plant tissue was removed mechanically at the soil level, weed control was 100% regardless of treatment time but was no more than 63% when tissue was removed just above the cotyledonary node. These data demonstrate the potential regrowth from axillary shoots when total control is not obtained. Findings also point to the slower activity of imazaquin and chlorimuron compared with the diphenyl ether herbicides.

Wild poinsettia heights were reduced 14 DAT for all herbicide treatments compared with the untreated check regardless of application time (Table 7.2). Applications of fomesafen, acifluorfen, or chlorimuron at POST1 reduced weed heights compared with the untreated check similarly to that of mechanical removal of the plant tissue at the soil level. Wild poinsettia heights were similar at POST2 for all herbicide treatments, but reduction compared with the untreated check was no more than 73%. Plant heights for imazaquin or acifluorfen treated wild poinsettia were similar at POST1 and POST2. Plant heights were greater for all herbicide treatments when applied at POST3 compared with earlier applications. As noted in the control ratings, soil level harvest of plant tissue resulted in

Table 7.2. **Wild poinsettia height 14 and 28 DAT as influenced by time of postemergence (POST) herbicide application, and mechanical removal at ground level and just above the cotyledonary node in greenhouse studies.**

		Wild poinsettia height					
		14 DAT			28 DAT		
Treatment	Rate	POST1[a]	POST2	POST3	POST1	POST2	POST3
	(kg ha^{-1})	(cm)					
Imazaquin	0.14	5.4(70)[b]	7.4(61)	20.3(44)	7.3(80)	12.4(71)	25.4(62)
Fomesafen	0.42	1.2(93)	5.1(73)	17.2(53)	1.0(97)	5.6(87)	24.0(64)
Acifluorfen	0.42	3.0(83)	5.2(73)	20.5(43)	2.9(92)	5.4(87)	26.0(61)
Chlorimuron	0.009	2.5(86)	6.3(67)	16.1(56)	1.0(97)	5.6(87)	15.0(61)
Mech-ground	-	0.0(100)	0.0(100)	0.1(100)	0.0(100)	0.0(100)	0.0(100)
Mech-first node	-	11.6(35)	11.5(39)	16.7(54)	29.0(21)	26.2(38)	33.3(50)
Untreated check		17.9(0)	19.0(0)	36.2(0)	36.6(0)	42.1(0)	66.8(0)
LSD (0.05)		3.7			4.2		

[a] POST1 (5 to 7 cm), POST2 (8 to 10 cm), and POST3 (15 to 20 cm).
[b] Values in parentheses represent percent reduction compared with the untreated check.

complete weed control. Increased plant heights, however, were common when plant tissue was removed above the cotyledonary node regardless of timing.

Similar trends in wild poinsettia heights were noted at 28 DAT, and all herbicide treatments reduced weed heights compared with either the untreated check or the mechanical removal of plant tissue above the cotyledonary node (Table 7.2). Fomesafen, acifluorfen, and chlorimuron treatments at POST1 reduced weed heights similar to the soil level removal of plant tissue. At either POST1 or POST2, applications of fomesafen, acifluorfen, or chlorimuron resulted in similar weed heights that were less than when imazaquin was applied. At POST3, weeds treated with chlorimuron were shorter than plants treated with imazaquin, fomesafen, or acifluorfen.

The number of lateral branches serves as an indicator of regrowth following the various weed control practices. Application of imazaquin resulted in increased lateral branch production compared with the other treatments regardless of timing of application (Table 7.3). Proliferation of axillary buds is common in plants treated with imazaquin due to the interference in hormonal status and loss of apical dominance (7.7). Lateral branches were not produced on weeds mechanically removed at the soil level. Weeds removed mechanically above the cotyledonary node produced more lateral branches than herbicide

Table 7.3. **Number of wild poinsettia lateral branches and dry weights 28 DAT as influenced by time of postemergence (POST) herbicide application and mechanical removal at ground level and just above the cotyledonary node in greenhouse studies.**

		Lateral branches			Dry weight		
Treatment	Rate	POST1[a]	POST2	POST3	POST1	POST2	POST3
	(kg ha^{-1})	(#/plant)			(g/pot)		
Imazaquin	0.14	5.2	9.7	8.7	0.11(90)[b]	0.26(82)	1.16(54)
Fomesafen	0.42	0.1	0.6	2.2	0.01(99)	0.06(96)	0.57(77)
Acifluorfen	0.42	0.3	0.9	2.3	0.01(99)	0.05(96)	0.57(77)
Chlorimuron	0.009	0.1	2.0	2.4	0.01(99)	0.07(95)	0.42(83)
Mech-ground	-	0.0	0.0	0.0	0.0(100)	0.0(100)	0.0(100)
Mech-first node	-	2.0	1.9	2.1	0.82(26)	0.77(45)	0.95(62)
Untreated check		1.2	4.0	2.4	1.11(0)	1.41(0)	2.53(0)
LSD (0.05)		1.0			0.26		

[a] POST1 (5 to 7 cm), POST2 (8 to 10 cm), and POST3 (15 to 20 cm).
[b] Values in parentheses represent percent reduction compared with the untreated check.

treatments except imazaquin at POST1. It is of interest that more lateral branches were produced by the untreated check.

Even though plant heights and numbers of lateral branches are indicative of response to weed control treatments, of major importance is their effect on biomass production. Wild poinsettia dry weights 28 DAT for all herbicide treatments were less than the untreated check regardless of treatment timing (Table 7.3). Herbicide treatment at POST1 or POST2 resulted in wild poinsettia dry weights similar to the mechanical treatment in which plant tissue was removed at the soil level. Biomass reduction compared with the untreated check for the herbicide treatments ranged from 90 to 99% (POST1) and 82 to 96% (POST2). At POST3, fomesafen, acifluorfen, or chlorimuron reduced weed biomass 77 to 83% which was greater than that for imazaquin. When wild poinsettia were mechanically removed above the first node, biomass reduction compared with the untreated check was no more than 62%. Unlike the herbicide treatments, mechanical removal of plant tissue above the cotyledonary node reduced biomass similarly regardless of application time.

Field Study. Wild poinsettia control 14 DAT was 91% for fomesafen and chlorimuron applied POST1 and 93% for chlorimuron at POST2. With the exception of imazaquin, weed control was similar for POST1 and POST2. Control was no more than 66% for any herbicide when applied at POST3.

At 28 DAT, weed height for the three marked weeds increased compared with the untreated check for all herbicides regardless of application timing (Table 7.4). For POST1, fomesafen, acifluorfen, and chlorimuron killed the marked plants; whereas imazaquin reduced weed height 56% compared with the untreated check. At POST2, acifluorfen and chlorimuron treatments reduced weed heights 88 and 95%, respectively. For POST3, weed heights were reduced no more than 53% by the herbicide treatments.

Similar responses were observed for plant height measured at flowering. All herbicides reduced plant heights compared with the untreated check regardless of timing. At POST1, the marked plants treated with imazaquin survived for the entire season while fomesafen, acifluorfen, and chlorimuron-treated plants were dead. When application was delayed until POST2, weeds were present for all herbicide treatments, and acifluorfen-treated weeds were shorter than those treated with fomesafen. At POST3, reduction in plant heights compared with the untreated check ranged from 27 to 82%, and imazaquin and chlorimuron-treated plants were shorter than those treated with fomesafen or acifluorfen. Comparing the application timings, plant heights of weeds treated with

Table 7.4. **Wild poinsettia control 14 DAT, and height 28 DAT and at flowering as influenced by time of postemergence (POST) herbicide application in the field study.**

		Weed control			Weed height					
		14 DAT			28 DAT			Flowering		
Treatment	Rate	POST1	POST2	POST3	POST1[a]	POST2	POST3	POST1	POST2	POST3
	kg ha^{-1}	(%)			(cm)			(cm)		
Imazaquin	0.14	80	71	50	7.6(56)[b]	11.2(59)	18.0(43)	25.2(61)	18.1(78)	27.7(66)
Fomesafen	0.42	91	86	56	0.0(100)	9.7(65)	17.8(44)	0.0(100)	25.4(68)	59.7(27)
Acifluorfen	0.42	84	89	63	0.0(100)	1.3(95)	19.0(40)	0.0(100)	5.8(93)	52.7(36)
Chlorimuron	0.009	91	93	66	0.0(100)	3.2(88)	14.8(53)	0.0(100)	12.5(85)	38.6(82)
Untreated check		0	0	0	17.1(0)	27.3(0)	31.7(0)	69.7(0)	80.7(0)	82.2(0)
LSD (0.05)		6			5.5			13.8		

[a] POST1 (5 to 7 cm), POST2 (8 to 10 cm), and POST3 (15 to 20 cm).

[b] Values in parentheses represent percent reduction compared with the untreated check.

imazaquin were similar while those treated with fomesafen, acifluorfen, and chlorimuron were lower at POST2 than at POST3.

For the three weeds marked at the time of herbicide application, lateral branches were counted throughout the season to determine the extent of regrowth. The number of lateral branches 14 DAT for individual application timings was similar for the treatments (data not shown). However, at 28 DAT the number of lateral branches following imazaquin was greater than that of the untreated check at POST2 or POST3 (Table 7.5). With the exception of imazaquin applied at POST2 and POST3, all herbicide treatments resulted in lateral branch production similar to the untreated check. At flowering, number of lateral branches was decreased by fomesafen, acifluorfen, and chlorimuron applied at POST1 compared with the untreated check. For POST2, number of lateral branches of weeds treated with fomesafen was similar to the untreated check while the number of lateral branches was reduced by acifluorfen and chlorimuron. Number of lateral branches of weeds treated with imazaquin at POST3 was higher compared with the untreated check but was similar to the untreated check for weeds treated with fomesafen, acifluorfen, or chlorimuron.

To determine the residual activity of the herbicides, the number of newly emerged wild poinsettia plants was

Table 7.5. **Number of wild poinsettia lateral branches 28 DAT and at flowering as influenced by time of postemergence (POST) herbicide application in the field study.**

		Lateral branches					
		28 DAT			Flowering		
Treatment	Rate	POST1[a]	POST2	POST3	POST1	POST2	POST3
	(kg ha^{-1})	(#/plant)					
Imazaquin	0.14	2.8	9.6	8.3	3.3	6.8	9.0
Fomesafen	0.42	0.0	2.9	4.2	0.0	3.9	3.9
Acifluorfen	0.42	0.0	0.3	5.0	0.0	0.4	5.5
Chlorimuron	0.009	0.0	1.0	5.8	0.0	1.4	5.8
Untreated check		2.5	3.3	3.8	4.3	5.6	4.3
LSD (0.05)		3.0			2.4		

[a] POST1 (5 to 7 cm), POST2 (8 to 10 cm), and POST3 (15 to 20 cm).

determined 14 and 28 DAT. Compared with the untreated check 14 DAT, the wild poinsettia population was reduced with fomesafen and acifluorfen at either POST1 or POST2 and with chlorimuron at POST2 (Table 7.6). Differences in plant numbers among the treatments were not detected. At 28 DAT, fomesafen, acifluorfen, or chlorimuron reduced the number of newly emerged wild poinsettia at least 74% compared with the untreated check at POST1, but differences were not detected among the herbicide treatments at POST2 or POST3. The lower residual activity of the herbicides applied at POST2 or POST3 was probably due to the large weeds intercepting the majority of the herbicide and preventing the herbicide from reaching the soil.

Three-leaf or larger wild poinsettia plants were counted at 14 and 28 DAT to evaluate the mortality of weeds as a consequence of herbicide application. Herbicide by application timing interactions were not detected, and data represent an average across application times or herbicide treatments (Tables 7.7 and 7.8). Fomesafen and chlorimuron decreased the population of large wild poinsettia 14 DAT approximately 55% compared with the untreated check (Table 7.7). POST1 and POST2 had similar numbers of wild poinsettia and were less than POST3 for both 14 and 28 DAT. At 28 DAT, all herbicides decreased the number of large wild poinsettia from 35% for chlorimuron to 66% for fomesafen. The change in mortality from 14 to 28 DAT

Table 7.6. **Number of newly emerged wild poinsettia plants per plot 14 and 28 DAT as influenced by time of postemergence (POST) herbicide application in the field study.**

		Wild poinsettia plants					
		14 DAT			28 DAT		
Treatment	Rate	POST1[a]	POST2	POST3	POST1	POST2	POST3
	(kg ha^{-1})	(#)					
Imazaquin	0.14	71.5(+2)[b]	11.3(62)	20.0(45)	56.0(+109)	5.8(63)	12.0(47)
Fomesafen	0.42	4.8(93)	1.5(95)	9.8(73)	1.0(96)	6.3(60)	21.5(4)
Acifluorfen	0.42	17.3(75)	2.3(92)	15.5(58)	6.3(76)	5.0(68)	11.0(51)
Chlorimuron	0.009	71.0(+2)	2.5(92)	21.5(41)	7.0(74)	8.8(44)	15.3(32)
Untreated check		69.8 (0)	30.0(0)	36.5(0)	26.8(0)	15.8(0)	22.5(0)
LSD (0.05)		26.8			13.1		

[a] POST1 (5 to 7 cm), POST2 (8 to 10 cm), and POST3 (15 to 20 cm).
[b] Values in parentheses represent percent reduction compared with untreated check.

Table 7.7. **Number of three-leaf or larger wild poinsettia 14 and 28 DAT and total wild poinsettia at flowering as influenced by herbicide treatments in the field study.**

		Wild poinsettia plants		
Treatment	Rate	14 DAT	28 DAT	Flowering
	(kg ha^{-1})	(#/plot)		
Imazaquin	0.14	44.3(28)[a]	38.0(48)	59.6(49)
Fomesafen	0.42	27.8(55)	24.9(66)	43.5(63)
Acifluorfen	0.42	40.3(35)	28.1(61)	45.2(62)
Chlorimuron	0.009	28.7(54)	47.3(35)	83.8(29)
Untreated Check		61.9(0)	72.9 (0)	117.3(0)
LSD (0.05)		24.6	17.3	26.0

[a] Values are averaged across postemergence timing treatments and those in parentheses represent percent reduction compared with the untreated check.

Table 7.8. **Number of three-leaf or larger wild poinsettia 14 and 28 DAT and total wild poinsettia at flowering as influenced by time of postemergence (POST) herbicide application in the field study.**

	Wild poinsettia plants		
Treatment	14 DAT	28 DAT	Flowering
	(#/plot)		
POST1	31.4[a]	38.0	73.1
POST2	28.2	27.9	50.3
POST3	59.3	60.8	86.3
LSD (0.05)	19.1	13.4	20.1

[a] Values are averaged across herbicide treatments.

indicates that imazaquin and acifluorfen had slower activity than fomesafen or chlorimuron. The total wild poinsettia plants per plot were counted at weed flowering to provide late season indication of weed response to the herbicide and time of application. Fewer wild poinsettia plants were present following application at POST2 than at POST1 or POST3 (Table 7.8). Herbicide treatments reduced wild poinsettia population compared with the untreated check (Table 7.7). Fomesafen and acifluorfen reduced wild poinsettia populations approximately 63% which was greater than that noted for chlorimuron.

Percent change in the wild poinsettia population was calculated based on the number of weeds present the day of herbicide application and at flowering. At POST1, fomesafen or acifluorfen reduced the wild poinsettia population compared with the untreated check. However, a 138% increase in weed population was noted for the untreated check indicating that new flushes of wild poinsettia emerged after the initial application. The POST2 application resulted in the greatest reductions in wild poinsettia populations since most of the weeds had emerged at that time and were at a size at which herbicide treatments were effective (data not shown). Specifically, fomesafen, acifluorfen, or imazaquin applied at POST2 decreased weed populations between 70 and 81%. At POST3, no differences were detected among the herbicide treatments, and the untreated check indicating that weeds were too large for adequate control.

Secondary inflorescences were counted at flowering on the three wild poinsettia plants marked in each plot at time of treatment. Compared with the untreated check, plants treated with fomesafen, acifluorfen, or chlorimuron had fewer secondary inflorescences per plant at POST1 while imazaquin, acifluorfen, or chlorimuron treated plants produced fewer secondary inflorescences at POST2. At POST3, no differences were observed between the untreated check and the herbicide treatments.

The estimated seed production per plant was calculated based on the average number of secondary inflorescences per plant, the average number of inflorescences per secondary inflorescence (48.1), and the number of locules (3) within each inflorescence. The untreated checks averaged 521 seeds per plant (Table 7.9). In contrast, Rodriguez and Cepero (7.6) reported that wild poinsettia grown in the laboratory produced an average of 106 seeds per plant.

Seed produced per plot was estimated by calculating seed per plant and the weeds present in each plot at flowering. More weed seed per plot were produced from wild poinsettia treated at POST3 than from those treated at POST1 or POST2 (data not shown). All herbicides reduced seed production per plot compared with the untreated checks regardless of application timing. Even though weed control with some of

Table 7.9. **Number of secondary inflorescences and estimated seed production at flowering as influenced by time of postemergence (POST) herbicide application in the field study.**

		Secondary inflorescences			Seed production		
Treatment	Rate	POST1[a]	POST2	POST3	POST1	POST2	POST3
	(kg ha^{-1})	(#/plant)			(#/plant)		
Imazaquin	0.14	2.17	0.50	2.16	313	72	313
Fomesafen	0.42	0.00	4.00	3.00	0	577	433
Acifluorfen	0.42	0.00	0.00	4.25	0	0	613
Chlorimuron	0.009	0.00	0.58	2.00	0	84	289
Untreated check		3.17	3.83	3.84	457	553	553
LSD (0.05)		2.12			306		

[a] POST1 (5 to 7 cm), POST2 (8 to 10 cm), and POST3 (15 to 20 cm).

the herbicide treatments was inadequate, their benefit could be evident in reduced weed pressure in subsequent years.

Weed dry weight per plot was determined in October (Table 7.10). At POST1, imazaquin or fomesafen reduced biomass compared with the untreated check 23 and 34%, respectively. Plants treated with fomesafen produced less biomass compared with acifluorfen and chlorimuron. At POST2, all treatments reduced biomass at least 30% compared with the untreated check. Weeds treated with imazaquin at POST2 produced less biomass than those treated with acifluorfen (49 vs 30%). At POST3, only imazaquin decreased biomass (47%) compared with the untreated check.

In both greenhouse and field studies, wild poinsettia control was as effective when herbicides were applied to wild poinsettia at 8 to 10 cm in height (POST2) as those applied earlier at 5 to 7 cm (POST1). When compared with POST1, POST2 minimized the adverse effects of subsequent flushes of weeds. Compared with the later application to wild poinsettia at 15 to 20 cm (POST3), POST2 reduced weed regrowth. Weed biomass in both greenhouse and field studies was generally reduced as much when herbicide was applied at POST2 than at POST1. At POST2, reductions in weed biomass were similar for imazaquin, fomesafen, acifluorfen, or chlorimuron.

Table 7.10. **Wild poinsettia dry weight per plot as influenced by time of postemergence (POST) herbicide application in the field study.**

		Wild poinsettia biomass		
Treatment	Rate	POST1[a]	POST2	POST3
	(kg ha^{-1})	(g)		
Imazaquin	0.14	423(23)[b]	291(49)	334(47)
Fomesafen	0.42	369(34)	368(36)	571(5)
Acifluorfen	0.42	530(5)	401(30)	497(18)
Chlorimuron	0.009	505(10)	357(38)	523(13)
Untreated check		559(0)	573(0)	603(0)
LSD (0.05)		119		

[a] POST1 (5 to 7 cm), POST2 (8 to 10 cm), and POST3 (15 to 20 cm).
[b] Values in parentheses represent percent reduction compared with the untreated check.

The field study allowed further comparison of residual activity of herbicides and their effect on weed seed production. Subsequent weed emergence indicated that all herbicides provided some residual activity and was highest when applied at POST1. Reduced residual activity for later applications was due to the inability of herbicides to reach the soil surface due to presence of large weeds. All herbicides reduced seed production compared with the untreated check, and herbicide application would be beneficial when long-term weed management is of concern.

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CHAPTER 8

SUMMARY

In area of influence studies, wild poinsettia exerted its influence on soybean growth and yield no more than 40 cm within the soybean row. Soybean dry weights decreased from 14 to 38% within 20 cm of the weed for 12 through 18 wk of interference. In both years, wild poinsettia plant height, canopy width, fresh weight, and dry weight were higher when growing alone than when growing with soybean. Weeds were much larger in 1991 than in 1990, possibly because rainfall from May through September 1991 was twice that of the previous year. This difference in weed size indicated that environmental conditions the second year were more conducive to weed growth and subsequent interference with the crop. Variation in weed growth could also explain why a 18% reduction in soybean seed yield within 10 cm of the weed occurred in 1991, whereas only a 9.4% loss was noted the previous year.

In the density/duration of interference studies, wild poinsettia removal within 8 wk after crop emergence was necessary to avoid a significant yield reduction. A yield reduction of 26%, however, was observed when weeds were allowed to compete for 10 wk. A density of 8 wild poinsettia plants per 6 m of row reduced soybean seed yield 17%. The presence of wild poinsettia at densities of less than 8 plants per 6 m of row may not contribute to a significant yield reduction but may increase percent moisture and/or foreign material content of the harvested seed. These quality factors could also be of economic importance.

Postemergence applications of chlorimuron, imazaquin, fomesafen, and acifluorfen following preemergence applications of clomazone, metribuzin, and metribuzin plus chlorimuron enhanced wild poinsettia control when compared with the preemergence herbicides applied alone, but soybean seed yields were not increased with additional postemergence applications. Applications of postemergence treatments following preemergence treatments reduced foreign material and percent moisture when an early freeze did not occur. The impact of such quality parameters on grade reduction and net returns when wild poinsettia is not controlled adequately should be considered. In similar studies, early postemergence (2 to 8 cm height) applications of fomesafen, acifluorfen, imazaquin, lactofen, and chlorimuron provided excellent wild poinsettia control. When weed control was reduced with a late postemergence application, percent foreign material and moisture in harvested soybean seed increased significantly.

In both greenhouse and field studies, weed control was as effective when imazaquin, fomesafen, acifluorfen, and chlorimuron were applied to wild poinsettia at 8 to 10 cm as when applied at 5 to 7 cm. Compared with the early application at 5 to 7 cm, application at 8 to 10 cm minimized the subsequent emergence of new weeds. The late application at 15 to 20 cm reduced weed regrowth compared with application at 8 to 10 cm. All herbicides reduced seed production and even though weed control was not always enhanced, their application would be of importance where long-term weed control is of concern.

APPENDIX A

CHEMICAL NOMENCLATURE

acifluorfen	5-[2-chloro-4-(trifluoromethyl)phenoxy]-2-nitrobenzoic acid
chlorimuron	2-[[[[(4-chloro-6-methoxy-2-pyrimidinyl) amino]carbonyl]amino]sulfonyl]benzoic acid
clomazone	2-[(2-chlorophenyl)methyl]-4,4-dimethyl-3-isoxazolidinone
fluazifop-P	(*R*)-2-[4-[[5-(trifluoromethyl)-2-pyridinyl]oxy]phenoxy]propanoic acid
fomesafen	5-[2-chloro-4-(trifluoromethyl)phenoxy]-*N*-(methylsulfonyl)-2-nitrobenzamide
imazaquin	2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1-*H*-imidazol-2-yl]-3-quinolinecarboxylic acid
lactofen	(±)-2-ethoxy-1-methyl-2-oxoethyl 5-[2-chloro-4-(trifluoromethyl)phenoxy]-2-nitrobenzoate
metolachlor	2-chloro-*N*-(2-ethyl-6-methylphenyl)-*N*-(2-methoxy-1-methylethyl)acetamide
metribuzin	4-amino-6-4,1-dimethylethyl-3-(methylthio)-1,2,4-triazin-5(4*H*)-one

VITA

Teresa Summerford Willard was born an July 21, 1961 to James and Nancy Ann Summerford in Pine Bluff, Arkansas. She was raised in rural Arkansas, near Star City, on an 800-acre family farm. She attended the Star City schools where she was president of the student council, a member of the All-state basketball team, and valedictorian (May, 1979) with a 4.0 gpa. She enrolled at the University of Arkansas-Monticello and became a member of the Alpha Chi Honor Society and All-NAIA basketball team, received the chemistry award, and graduated Magna Cum Laude in May, 1983. Ms. Willard moved to Baton Rouge, Louisiana, and was employed by Ethyl Corporation as a chemist in 1983. As a result of her work at Ethyl Corporation, she has received two United States patents. She was married to David Ray Willard in March of 1988. In August of 1988, she enrolled in graduate school at Louisiana State University under the direction of Dr. James L. Griffin in the Department of Plant Pathology and Crop Physiology. Ms. Willard is a candidate for the Doctor of Philosophy degree in Plant Health with a research area in Weed Science. While attending Louisiana State University, Ms. Willard was a member of the LSU weed team in 1990 and 1991, became a member of the Gamma Sigma Delta Honor Society, received first place in the graduate student paper competition of the Louisiana Plant Protection Association (1992), and presented a total of five papers and posters at the Southern Weed Science Society and the Weed Science Society of America meetings.

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Title of Dissertation: Interference, Management, and Growth Response of Wild Poinsettia (Euphorbia heterophylla L.) in Soybean

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